A Framework of Strategies to Mitigate the Frequency and Impact of Human-Elephant Conflicts in the Game Reserve Areas of Zimbabwe

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ABSTRACT

This study examined a framework of strategies to mitigate the frequency and impact of Human Elephant Conflicts (HEC) in the Game Reserve areas of Zimbabwe. The research was conducted specifically in Malipati, a lowveld area of Zimbabwe. In explaining the study, researchers used the social ecological theory by Berkes and Folke, (1998). Researchers employed a mixed-methods approach, combining a cross-sectional survey. The target population were Zimparks personnel, community members, and local leaders. The study's population was estimated to be 142. This implied that according to the Krejcie and Morgan's sample size determination the sample size became 105. The analysis of quantitative data was done using SPSS version 23 software whilst qualitative data was analysed using NVivo version 12. The research found that strategies that includes educational outreach programs, compensation schemes for property damage, fencing initiatives, and the use of deterrents like alarms and scarecrows may be used to mitigate the frequency and impact of Human-Elephant Conflicts in the Game Reserve areas of Zimbabwe. Study recommended that government ensure compensation schemes for victims of HEC that are fair and transparent.

INTRODUCTION

Elephants are one of the Big Five species, possessing national, regional, and worldwide significance as a source of revenue through ivory trade and tourism. Consequently, the focus is directed towards their survival and habitats. For numerous individuals residing near wildlife reserves, elephants can represent a daunting reality. The FAO (2008) asserts that more than 80% of the elephant habitat in Africa is situated beyond protected zones, resulting in heightened interactions between farmers and elephants. Rural populations bear the principal costs associated with coexisting with elephants, although they derive minimal advantages from activities like eco-tourism and sport shooting (Pisa & Katsande, 2021).

Consequently, local farmers often harbor negative opinions towards elephants. Agriculturalists possess few resources to safeguard themselves and their properties against these colossal beasts, and the culling of destructive individuals is forbidden by both international and national legislation (FAO, 2008). Human-elephant conflict (HEC) constitutes a significant conservation challenge in countries where elephants are found. Various management solutions for preventing and mitigating human-elephant conflict have been implemented in different sizes (Joshi et al., 2022; Mukeka, 2020). Nonetheless, HEC endures, as the majority of recognized prevention methods are influenced by site-specific factors that yield only temporary solutions, whereas mitigation tactics generally transfer conflict risk from one area to another. (Shaffer et al., 2019). Human-elephant violence has escalated in various African elephant-range countries, including Zimbabwe. (Gross et al., 2022).

Although elephants and humans have cohabited in Africa for 250,000 years and have shared resources to a degree (Buchholtz et al., 2019), the conflict between these species is escalating due to rising human populations and habitat fragmentation (Nyumba et al., 2020). The expansion of human settlements and agricultural

zones in Asia and Africa has led to significant habitat loss for elephants, diminished forage availability, and reduced landscape connectivity (Musiwa et al., 2020). The principal reasons for elephant habitat loss are the growth in human population and land-use alteration, which have dramatically altered the dynamics of social and ecological systems (Mumby and Plotnik, 2018). HEC presents a considerable conservation challenge in Africa, inflicting harm to crops and property, and occasionally resulting in human casualties and elephant mortality. Köpke et al. (2021) report that in Sri Lanka, an average of 200 animals are intentionally killed each year, resulting in 70 to 80 recorded human injuries. Mortality rates among elephants have been observed to be elevated.

Zimbabwe possesses the world's second-largest elephant population, following Botswana, and comprises approximately one-quarter of all elephants in Africa. (Dube, 2023). Gonarezhou National Park in southwestern Zimbabwe hosts a substantial elephant population, and human-elephant conflict (HEC) is a significant issue (Terada et al., 2021). Elephants can inflict significant economic and social damage by destroying property, and crops, and potentially assaulting humans (Anjum, 2023). HEC, conversely, engenders poverty and trauma among rural populations. Human-elephant conflict constitutes a significant conservation issue in the range of areas of Zimbabwe (Sime et al., 2020). Conflict endures despite diverse management strategies due to site-specific attributes and risk allocation (Shaffer et al., 2019). In 2020, Zimbabwe recorded around 50 injuries and 60 fatalities resulting from escalating wildlife-human conflict, as reported by ZimParks (2021). This was an increase of over fifty percent compared to the prior year.

A significant portion of the endeavor to manage and minimize human-elephant conflict (HEC) has been on prevention through the separation of humans and elephants (Shaffer et al., 2019). Ecological corridors have been implemented to address the ecological requirements and behavioral traits of both humans and elephants, thereby mitigating human-elephant conflict by offering elephants alternative pathways for seasonal migration and facilitating their foraging behavior for resources and water (Adams et al., 2017). Although ecological corridors are gaining traction in Asia and Africa (Puyravaud et al., 2017), development pressures and infrastructure expansion within or adjacent to elephant habitats are often executed without regard for ecological consequences. Additionally, ecological corridors, or fencing for a Protected Area (PA), may result in "green grabbing", when subsistence farmers are deprived of access to communally owned arable land along elephant migration routes that are enclosed to reduce human-elephant conflict (Thakholi, 2016).

The research is based on Social-Ecological Systems Theory. Berkes and Folke (1998) assert that social-ecological systems integrate human and natural systems, emphasizing the necessity of perceiving humans as integral to nature rather than apart from it. It delineates a cohesive system of social and biophysical components that consistently engage in a resilient, enduring manner. It delineates a system that can be hierarchically interconnected and is defined across several temporal, geographical, and organizational dimensions. It highlights a collection of essential resources (natural, economical, and cultural) whose utilization and distribution are governed by a combination of social and ecological mechanisms. The hypothesis elucidates a constantly evolving, intricate system characterized by ongoing adaptation (Frank & Glikman, 2019).

Figure 1. Social-ecological theory
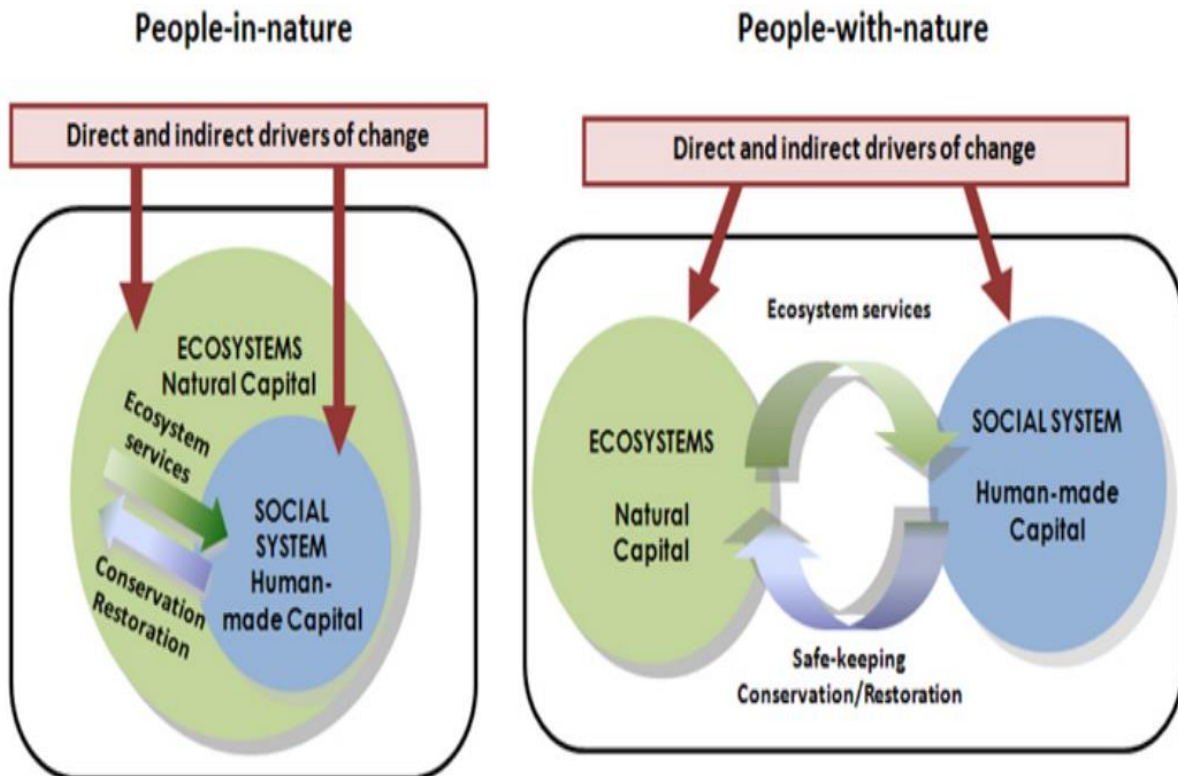
Source: Berkes and Folke, (1998)

The primary method utilized to assess Geographic Information System technologies' capacity to reduce human-elephant conflict and foster cohabitation was the socio-ecological systems (SES) approach, which recognizes that both social and ecological dynamics and feedbacks influence animal and human behavior. Accordingly, studies see human-elephant conflict as an interaction between two species, humans and animals, whose characteristics and behaviors have coevolved over overlapping time and spatial scales (Biset et al. 2019).

The study uses the definition presented by Carter and Linnell (2016) to understand coexistence as a dynamic but sustainable state that involves adjusting human interactions with wildlife to ensure co-adaptation, suggesting that coexistence with wildlife requires more intention than merely existing in the same place at the same time (Mojo et al., 2020). Thus the theory forms relevance in this study on the use of Geographic Information System techniques to minimize human-elephant conflict as it proposes social effectiveness that incorporates both ecological effectiveness and social acceptability (McKee et al 2021). Thus, this research seeks to develop community-based strategies to mitigate Human-Elephant Conflicts in the Game Reserve areas of Zimbabwe.

METHODS

The study employed a mixed-methods research approach. The research was underpinned by a pragmatism research philosophy in which cross-sectional survey research was adopted (Ado et al., 2016). The researcher gathered quantitative data through 5-point structured and Likert-scaled questionnaires. On the other hand, qualitative data were gathered through an interview guide. The target population was Zimparks personnel, community members, and local leaders. The study's population was estimated to be 142. This implies that according to Krejcie and Morgan's sample size determination, the sample size became 105. Purposive sampling was used as a sampling s The analysis of quantitative data was done using SPSS version 23 software whilst qualitative data was analyzed using NVivo version 12.

RESULTS AND DISCUSSION

According to the study, 105 participants were reached, and 80 of them completed and returned usable questionnaires, generating a 76% response rate. According to Hundall (2015), a response rate

of 60% to 85% is appropriate for quantitative research, therefore the response rate supports the validity and dependability of the findings. The main objective of this study was to determine strategies

that can be put in place to mitigate HEC in game reserve areas of Zimbabwe. As such the following Table 1 gives the descriptive statistics.

Table 1. Descriptive Statistics Strategies to Mitigate Human-Elephant Conflict

Item Code	Item Description	Mean score	Mean response	SD
OS1	Creating awareness through education	3.20	Agree	.772
OS2	Employment and empowering local communities	3.63	Agree	1.086
OS3	Compensation for damaged property	3.50	Agree	1.009
OS4	Proper waste management	3.62	Agree	.006
OS5	Fencing	3.60	Agree	.005
0S6	Culling elephants	3.21	Agree	.770
0S7	Sound alarms/bells	3.23	Agree	.774
Overall		3.64	Agree	.888

Source: Primary data (2024)

Table 1 presents the results, with mean scores ranging from 3.20 (standard deviation 0.772) for item OS1 to 3.63 (standard deviation 1.086) for item OS2. The overall means Other strategies that can be put in place to curb HEC in the Malipati area.

Figure 2: Strategies that can be put in place to curb HEC in Malipati area

Source: Primary data 2024

Training and Education

Interviewee 1 had to say: "Training of farmers on elephant behavior and habitat needs helps them understand and predict elephants' movements reducing crop damage and conflict. Education on sustainable land use practices, such as agroforestry and permaculture is required".

Interviewee N1 had to say: "Training on GIS analysis and mapping to help conservationists and communities identify conflict hotspots and develop spatial plans for habitat restoration and corridor creation This builds capacity for data-driven conservation".

Interviewee 1 emphasized the need to train farmers on elephant behavior and sustainable land

use practices. This suggests that local knowledge gaps contribute to conflict, and that education can empower communities to anticipate and avoid elephant encounters. By adopting agroforestry and permaculture, farmers may reduce land degradation and create buffer zones, aligning with the social-ecological systems (SES) theory which highlights the importance of integrating ecological understanding into local practices (Blundo-Canto et al., 2025).

Interviewee N1 highlighted the importance of GIS training for mapping conflict hotspots and planning corridors. This indicates a shift toward data-driven conservation, enhancing the capacity of both communities and conservationists to make informed, long-term spatial decisions(Fletcher & Toncheva, 2021). This aligns with SES theory's emphasis on adaptive co-management and local capacity building (Sharma et al., 2020).

Employment of Locals

Interviewee, N1 had to say: "Employing local community members as conservation scouts and wildlife monitors creates a sense of ownership and responsibility, motivating them to protect elephant habitats and prevent conflict. They also serve as effective ambassadors promoting coexistence among their peers".

N1 noted that employing locals as scouts and wildlife monitors fosters ownership and accountability. This reflects the principle of community-based resource management, a key element of SES theory. By involving communities directly in conservation, the strategy strengthens

social capital and encourages behavioral change toward coexistence(Hailemicheal et al., 2025).

Compensation

"Compensating farmers for crop damage and property losses due to elephant encroachment helps reduce conflict acknowledges the value of their livelihoods and encourages them to tolerate elephant presence promoting coexistence". The view that compensation reduces resentment and fosters tolerance reflects a recognition of local livelihoods within conservation frameworks. This approach can serve as a social incentive, acknowledging economic losses while promoting peaceful human-elephant coexistence(Long et al., 2020). It also underlines the need for equity and justice, core values in the SES framework.

Waste Management

"Having proper waste management reduces attractants for elephants such as food waste and crops, thereby decreasing encroachment into agricultural lands and reducing conflicts". Proper waste management was identified as crucial to reducing elephant attractants. This insight demonstrates how seemingly small, practical measures can have significant ecological outcomes. It reinforces the SES perspective that social behaviors such as waste disposal are tightly linked to ecological responses to elephant movement (Matsuura et al., 2024).

Fencing

"Strategic fencing in high conflict areas helps funnel elephants into designated corridors, reducing encroachment into human-dominated landscapes and minimizing the risk of human-elephant conflict" score is 3.64 (standard deviation 0.888). These results suggest that the proposed strategies can be effective in mitigating HEC in the Malipati area.

The suggestion of strategic fencing in high-conflict zones points to the need for landscape-level planning. Such physical interventions, when carefully placed, can support habitat connectivity while reducing human-elephant encounters. This strategy aligns with SES theory's call for integrating ecological infrastructure into human-dominated systems Ferreira (Ferreira et al., 2019).

This study aimed to develop community-based strategies to mitigate human-elephant conflicts in Zimbabwe's game reserve areas specifically the Malipati area. Through a thorough literature review

and descriptive statistics as well as qualitative data analysis the research identified a wide range of effective strategies that can be employed for the frequency and impact of these conflicts.

The study thus concludes that education and employment of locals mitigate the occurrence of human-elephant conflicts. Educating local communities about the importance of conservation and the benefits of co-existing with elephants reduces the likelihood of conflicts arising from the human-wildlife interface. Additionally, providing employment opportunities in conservation efforts can empower local communities to take ownership of conflict mitigation strategies. Additionally, compensation for damaged property is essential for maintaining positive relationships between local communities and conservation efforts. Providing fair and timely compensation for damages caused by elephants helps reduce the likelihood of retaliatory actions against elephants and promotes a culture of co-existence (König et al 2020). The study also concludes that proper waste management is critical in reducing the attractiveness of human settlements to elephants. Ensuring that waste is disposed of properly reduces the chances of elephants encroaching on human settlements in search of food thereby reducing the risk of conflicts (Hariohay et al., 2020). Fencing can be an effective strategy in mitigating human-elephant conflicts. Creating such physical barriers between human settlements and elephant habitats reduces the likelihood of encounters between humans and elephants thereby reducing the risk of conflicts. Culling of such elephants must be considered as a last resort in mitigating such human-elephant conflicts (Jiang et al., 2021). While culling provides temporary relief from conflicts, it may not address the root causes of conflicts and can have negative impacts on elephant populations. Sound alarms and bells can be used to deter elephants from encroaching on human settlements. Using noise-making devices can create a barrier between humans and elephants, reducing the likelihood of encounters and conflicts (Hoare et al., 2020).

This finding aligns with Treves and Bruskotter (2014), who advocate for market-based strategies that provide financial compensation to affected communities. As Treves and Bruskotter (2014) highlight, the perceptions and attitudes of people living alongside elephants are crucial for successful

conflict management. Additionally, offsetting economic losses can foster positive attitudes towards wildlife and tolerance for elephants (Snyman, 2014).

Furthermore, the African Elephant Fund (2018), in collaboration with the Conservation Alliance and Ghana's Wildlife Division, implemented a project titled "Reducing human-elephant Conflict through improved monitoring, stakeholder engagement, and law enforcement". This project recommended biodiversity education programs to equip communities with knowledge and practices to protect crops while supporting elephant conservation.

Mandal and Das Chatterjee (2023) provide additional mitigation techniques, including using chili pepper-infused clothing hung on fences and establishing bee colonies at borders to deter elephants from approaching communities.

CONCLUSIONS

In conclusion, this study has identified a range of strategies that can be employed to mitigate human-elephant conflicts in Zimbabwean game reserve areas. By implementing and monitoring strategies Creating awareness through education, employment, and empowering local communities, culling compensation for damaged property, proper waste management, and fencing the frequency and impacts of conflicts may be reduced thus promoting conservation and enhancing human-wildlife conservation. It is thus essential to engage local communities in decision-making and implementation processes, provide education and training on conflict mitigation strategies, and establish compensation schemes for damaged properties. Future studies can thus look at the long-term effectiveness and sustainability of community-led human-elephant conflict mitigation strategies in Zimbabwe's game reserves. The study recommends that to curb human-wildlife conflict authorities should establish community led initiatives to develop and implement conflict mitigation strategies tailored to local needs and contexts. It is also recommended that the government ensure a compensation scheme that is fair and transparent.

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